

# **AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)**



for  
**LIQUID FUEL SYSTEMS MAINTENANCE**  
**(3E4X2)**

**MODULE 12**  
**TOOLS AND EQUIPMENT**

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TOOLS AND EQUIPMENT

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Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

OPR: HQ AFCESA/CEOF  
(SMSgt Jim Lucas)

Certified by: HQ AFCESA/CEO  
(Colonel Lance C. Brendel)

**Notice.** This AFQTP is NOT intended to replace the applicable technical references nor is it intended to replace hands-on training. It is to be used in conjunction with these for training purposes only.

**AIR FORCE QUALIFICATION TRAINING PACKAGES**  
**for**  
**LIQUID FUEL SYSTEMS MAINTENANCE**  
**(3E4X2)**

**INTRODUCTION**

*Before starting this AFQTP*, refer to and read the “Trainee/Trainer Guide” located on the AFCEA Web site <http://www.afcesa.af.mil/>

*AFQTPs are mandatory and must be completed* to fulfill task knowledge requirements on core and diamond tasks for upgrade training. *It is important for the trainer and trainee to understand* that an AFQTP **does not** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

*AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.*

**MANDATORY minimum upgrade requirements:**

***Core task:***

AFQTP completion  
Hands-on certification

***Diamond task:***

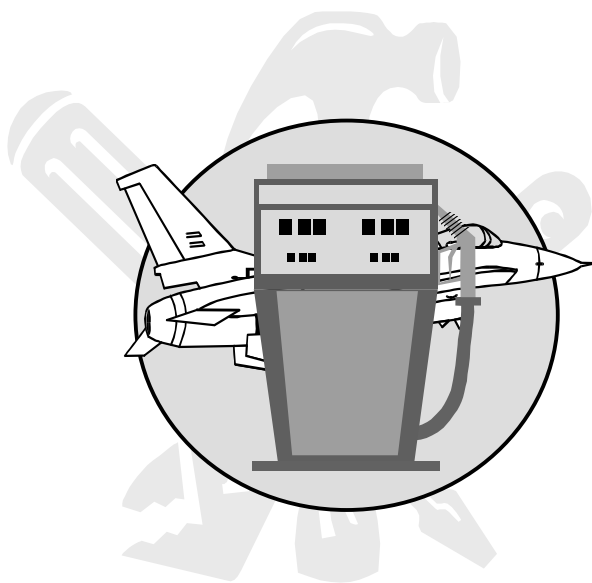
AFQTP completion  
CerTest completion (80% minimum to pass)

**Note:** *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

***Put this package to use.*** Subject matter experts under the direction and guidance of HQ AFCEA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

HQ AFCEA/CEOF  
139 Barnes Dr. Suite 1  
Tyndall AFB, FL 32403-5319  
DSN: 523-6380, Comm: (850) 283-6380  
Fax: DSN 523-6488  
E-mail: [ceof.helpdesk@tyndall.af.mil](mailto:ceof.helpdesk@tyndall.af.mil)

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## TOOLS AND EQUIPMENT

**MODULE 12**

**AFQTP UNIT 4**

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### USE VAPOR/OXYGEN INDICATOR (12.4.)

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**USE VAPOR/OXYGEN INDICATOR*****Task Training Guide***

<b>STS Reference Number/Title:</b>	12.4., Use Vapor/oxygen indicator
<b>Training References:</b>	<ul style="list-style-type: none"> <li>• T.O. 11H5-35-1</li> <li>• CDC 3E452</li> </ul>
<b>Prerequisites:</b>	<ul style="list-style-type: none"> <li>• Possess as a minimum a 3E432 AFSC.</li> </ul>
<b>Equipment/Tools Required:</b>	<ul style="list-style-type: none"> <li>• BACHARACH 514M or equivalent</li> </ul>
<b>Learning Objective:</b>	<ul style="list-style-type: none"> <li>• Trainee will know how to use a vapor/oxygen indicator</li> </ul>
<b>Samples of Behavior:</b>	Trainee will know how to: <ul style="list-style-type: none"> <li>• Connect calibration equipment</li> <li>• Perform operational checks</li> <li>• Conduct a vapor test</li> </ul>
<b>Notes:</b>	
<ul style="list-style-type: none"> <li>• To successfully complete this element follow the steps outlined in the applicable technical manual—no exceptions</li> <li>• Equivalent indicators may be found in Table of Allowance(TA) 488, Section C</li> </ul>	

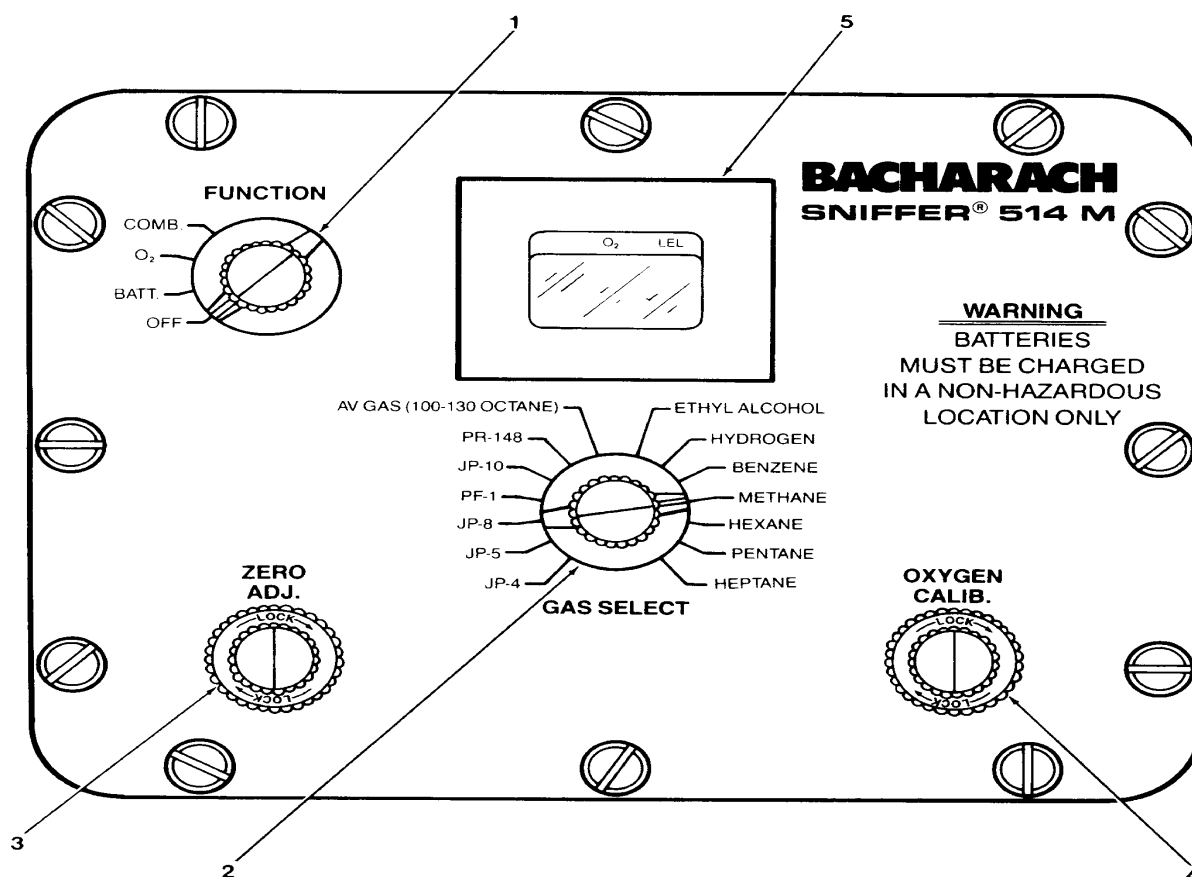
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## USE VAPOR/OXYGEN INDICATOR

**Background:** Prior to the invention of the BACHARACH 514M indicator, miners, oil field workers, and other people who worked in hazardous, explosive atmospheres depended on their nose. Later, other types of crude vapor indicators were available besides the nose, but today they would probably horrify the Humane Society. Some of these antiquated methods were mice and birds placed in suspected hazardous areas. If they lived, those areas were assumed safe; but if they died, you waited a little while longer, or ventilated. So the importance of this piece of equipment has evolved for your safety.

Technical Order 11H5-35-1 was used for the development of this AFQTP. The indicator is a portable hazardous vapor monitor designed to detect toxic and combustible levels of combustible gases and combustible vapors. The unit is used to sample atmospheres in confined spaces before and during entry by maintenance or inspection personnel. The concentration of gas or vapor is displayed in percent of lower explosive level (% LEL) on a liquid crystal display. The indicator also measures oxygen concentration. Audible and visual alarms are provided to warn the operator of impending hazardous conditions.

Before using the indicator, ensure that it has been calibrated and that the calibration is current. There should be a calibration label attached to the monitor certified by PMEL. Perform an inspection on the associated hoses and fittings, looking for cracks and obstructions. Familiarize yourself with the controls and indicators as seen in Figure 1 below. The purpose of an operational checkout is to determine whether the alarm is able to properly perform its mission. (See chart for description of components.)



**Figure 1, Controls and Indicators**

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Component	Function
FUNCTION switch	Turns indicator on and off. Selects variable to be displayed on LCD
GAS SELECT switch	Selects the type of combustible gas or vapor to be detected
ZERO ADJ. Potentiometer	Sets reference voltage for zero meter reading in combustible-free environment. Sets reference level for oxygen concentration in normal environment
Liquid crystal display	Displays battery voltage level, oxygen concentration, or %LEL continuously, depending on FUNCTION switch setting. Displays error code in event of component failure. Provides visual indication in case of alarm condition.
Audio transducer	Audible alarm to indicate conditions outside of pre-set limits.

*To perform the task, follow these steps:*

**NOTE:**

If unit gives error indication, or fails to perform as described during any step of the operational checkout, the alarm must be serviced before use.

**Step 1: Check startup.**

Turn indicator on by setting FUNCTION switch to BATT. position. Check that indicator steps through power on sequence. Verify that battery voltage is above 5.2 volts. If voltage indicated is 5.2 volts or less, charge indicator before proceeding.

**Step 2: Check pump flow rate.**

Connect flowmeter to inlet fitting as shown in Figure 2. If flow indicated is less than 1 scfh, refer to troubleshooting procedures in the technical manual.

**Step 3: Check alarms.**

Set FUNCTION switch to O<sub>2</sub> position and observe display until stable indication is given. Loosen lock ring on OXYGEN CALIB. Potentiometer, adjust for indication less than 19.5 %, verify audible and visual alarms. Adjust potentiometer to 20.9%, verify alarms deactivation, tighten lock ring. Set GAS SELECT switch to METHANE position, connect drying tube to indicator. Set FUNCTION switch to COMB. Position and observe display until stable. Loosen lock ring on ZERO ADJ. Potentiometer, adjust until display is 0, tighten ring. Assemble calibration components as seen in Figure 3 using methane calibration gas. Open gas valve, if less than 50psi replace calibration tank. Ensure there is positive flow on the flow meter at all times during checkout. Verify that display indicates a reading of 0 – 5% above the rating for the calibration gas and that alarms are given.

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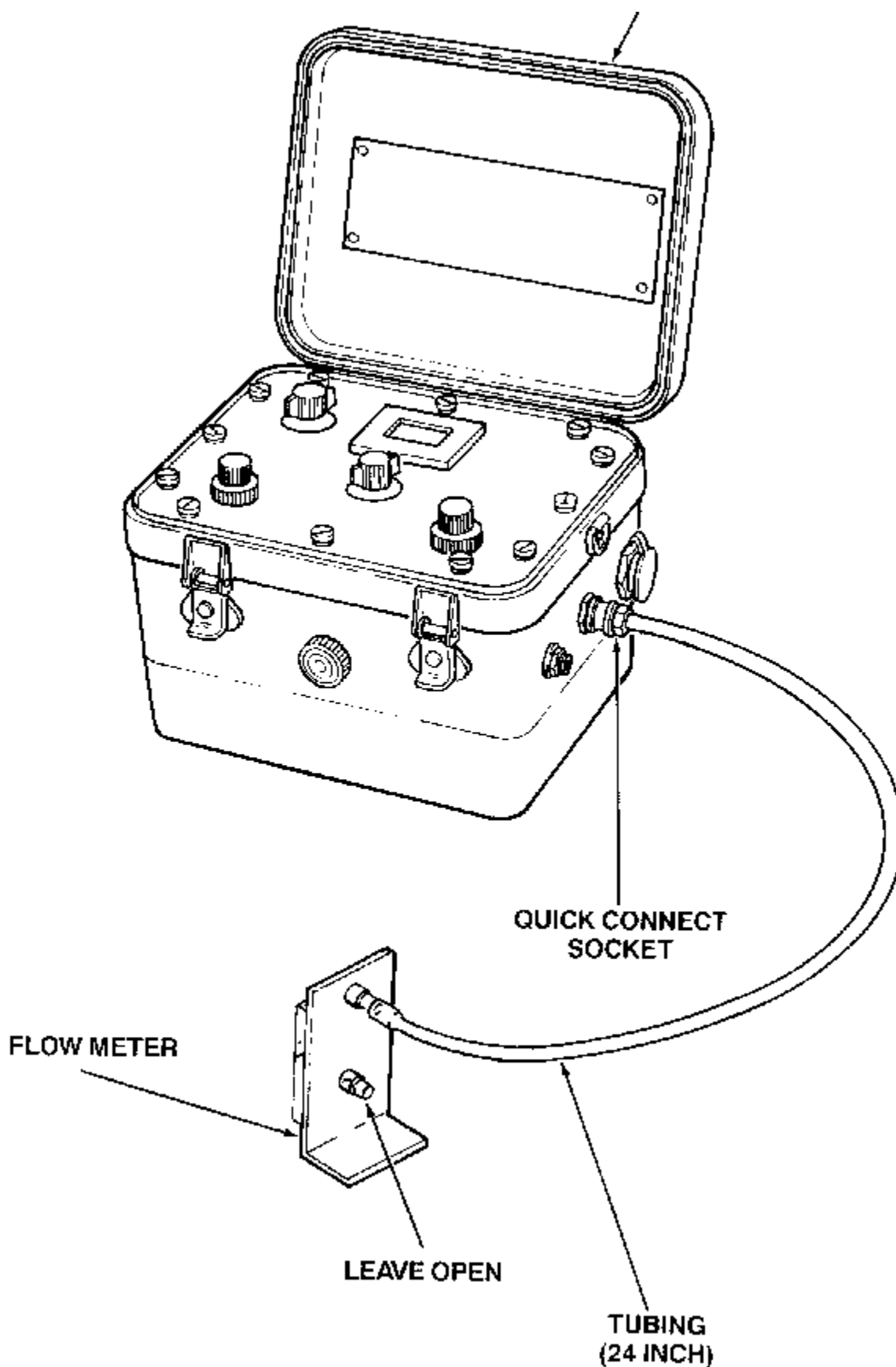


Figure 2, Flowmeter Setup

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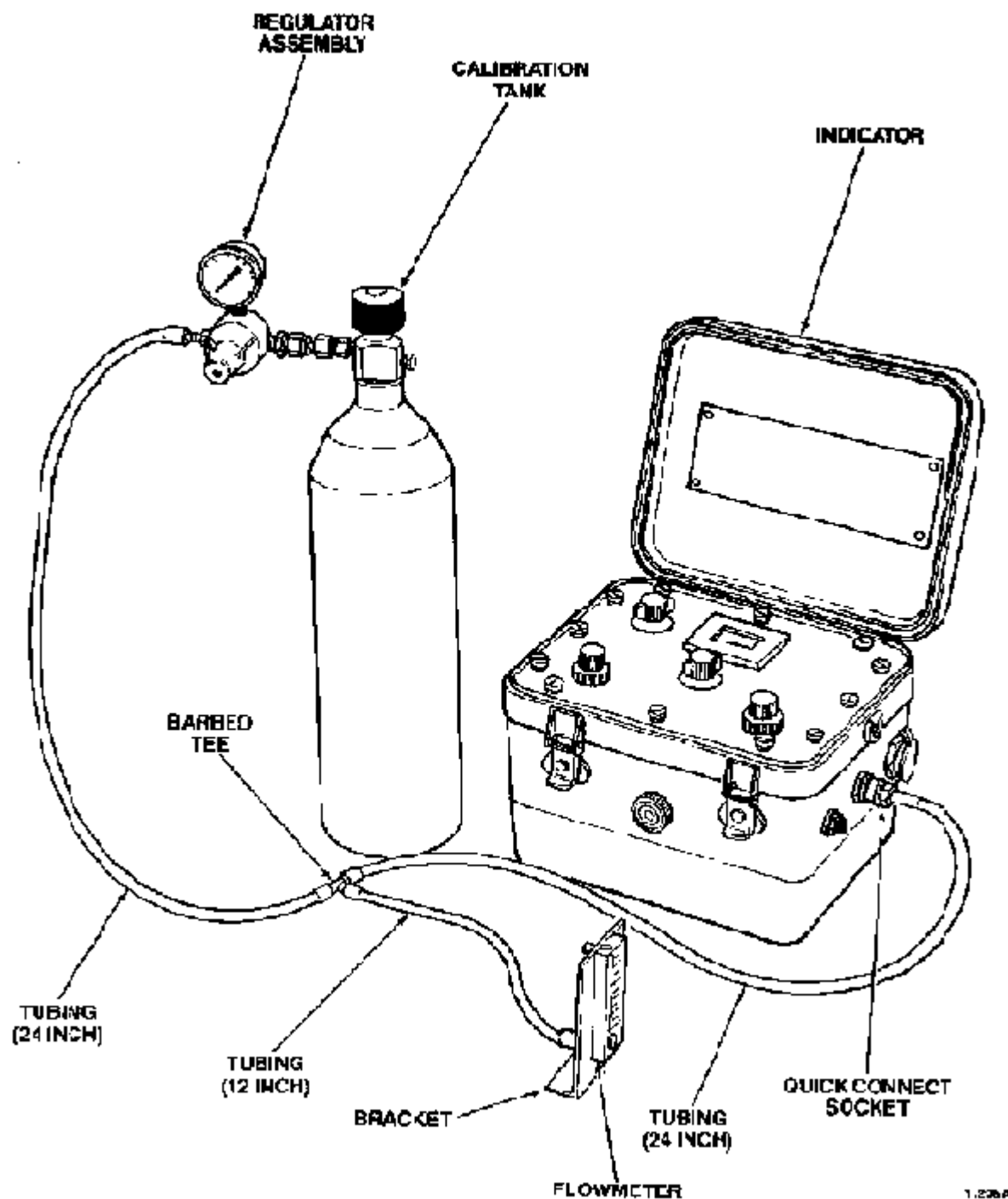


Figure 3, Calibrator Setup

**Step 4: Verify Oxygen Cell.**

Connect 24-inch tubing, you need to blow into the tube for 10 seconds, to lower oxygen level. If no reduction in reading, see technical manual for troubleshooting. Disconnect tubing. Indicator is now ready for use.

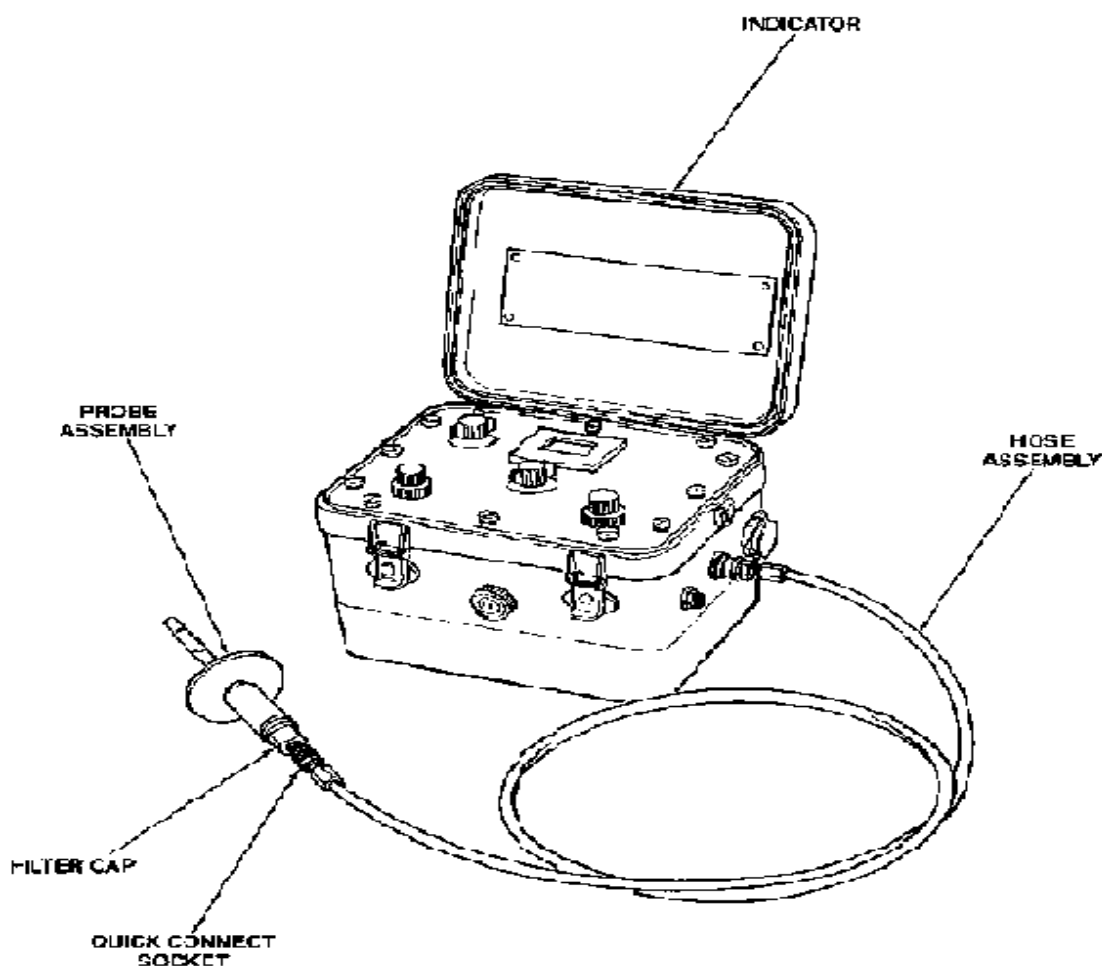
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**NOTE:**

Steps 1-4 complete the operational check. The remaining steps are for normal operations.

**Step 5: Normal Startup.**

While still in a fresh air location, connect desired hose assembly and probe to indicator (See Figure 4). Turn indicator on by setting FUNCTION switch to BATT. position. Observe display and ensure the LCD accomplishes a self-test (Indicator should display triple 0 thru triple 9 then triple -, E, H, L, and P). Errors during the self-test are indicated by displaying an error message (for example: E-1) and should be referred to the technical manual. Verify that battery voltage is above 5.2 volts. If voltage indicated is 5.2 volts or less, charge indicator before proceeding.



**Figure 4, Normal Operation Setup**

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**Step 6: Set O<sub>2</sub> Setting.**

Set FUNCTION switch to O<sub>2</sub> position and observe display until stable indication is given. Loosen lock ring on OXYGEN CALIB. Potentiometer, adjust for indication less than 20.9 %, tighten lock ring.

**Step 7: Select Vapor to be tested.**

Set GAS SELECT switch to combustible gas or vapor to be detected.

**NOTE**

If type of gas to be detected is unknown, set indicator for JP-5.

**Step 8: Zero readings.**

Set FUNCTION switch to COMB. Position and observe display until stable. Loosen lock ring on ZERO ADJ. Potentiometer, adjust until display is 0, tighten ring.

**Step 9: Begin testing area.**

Set FUNCTION switch to variable to be displayed. Insert probe into area. Indicator maybe used to sample continuously for 10.5 hours on a full charge.

**SAFETY:**

**DO NOT IMMERSE THE PROBE INTO LIQUID.**

**NOTE:**

Allow indicator to draw sample for a minimum of 30 seconds or until stable indication is observed.

**Step 10: Shutdown**

At the end of sampling operation, sample from a gas free area for 10 seconds to purge indicator. Set Function switch to Batt position and verify voltage is above 5.2. Set FUNCTION switch to OFF position. If voltage was below 5.2, charge indicator for next use.

### Review Questions for Use Vapor/Oxygen Indicator

Question	Answer
1. In what units is the concentration of vapors displayed on the vapor/oxygen indicator?	a. Gallons b. % LEL c. gallons per minute(gpm) d. % PPM
2. Before using the meter you must ensure what?	a. The lights are working b. Batteries are installed c. Calibration is current d. Vapors are present in the area
3. What does the FUNCTION switch do?	a. Select the type of gas to detect for b. Zero the O <sub>2</sub> reading c. Turn the indicator on and off
4. What voltage must the battery have to use the vapor/indicator?	a. < 5.2 b. 5.2 c. <5.0 d. >5.2
5. Which switch is turned to check the battery voltage level?	a. FUNCTION switch to level check b. FUNCTION switch to Batt. c. GAS SELECT switch to level check d. GAS SELECT switch to Batt.
6. What do you set the vapor/oxygen indicator GAS SELECT switch to if the vapor being detected is unknown?	a. JP-5 b. JP-4 c. Methane d. Benzene
7. When taking a sample, what is the minimum time you should allow the indicator to draw in a sample of the atmosphere?	a. 10 sec b. 15 sec c. 20 sec d. 30 sec

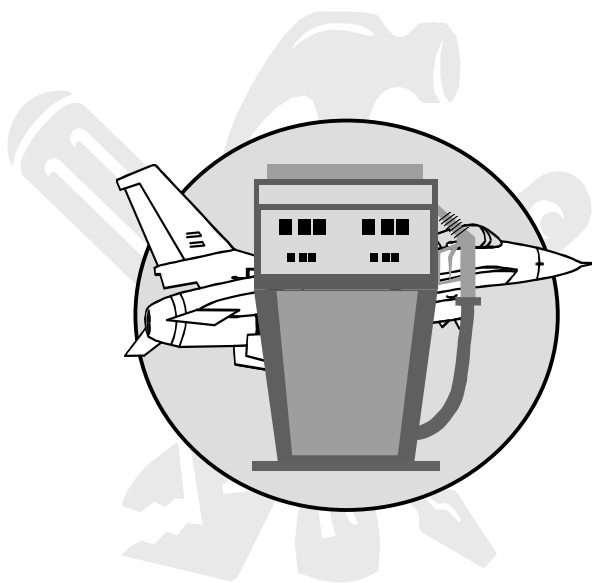
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## USE VAPOR/OXYGEN INDICATOR

Performance Checklist		
Step	Yes	No
1. Did trainee observe startup sequence?		
2. Did trainee check pump flow rate?		
3. Checked alarms: a. Did trainee verify Oxygen alarm? b. Did trainee verify LEL alarm?		
4. Did trainee check O <sub>2</sub> cell?		
5. Did trainee check assembled meter for normal sampling?		
6. Did trainee set O <sub>2</sub> setting?		
7. Did trainee select vapor to be detected?		
8. Did trainee check for zero reading?		
9. Did trainee properly sample area?		
10. Did trainee follow proper shutdown procedures?		

**FEEDBACK:** Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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## TOOLS AND EQUIPMENT

**MODULE 12**

**AFQTP UNIT 5**

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### USE MASTER METER (12.5.)

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**USE MASTER METER*****Task Training Guide***

<b>STS Reference Number/Title:</b>	12.5., Use Master Meter
<b>Training References:</b>	<ul style="list-style-type: none"> <li>• T.O. 33A6-7-13-11</li> <li>• CDC 3E452</li> </ul>
<b>Prerequisites:</b>	<ul style="list-style-type: none"> <li>• Possess as a minimum a 3E432 AFSC</li> </ul>
<b>Equipment/Tools Required:</b>	<ul style="list-style-type: none"> <li>• Master Meter</li> <li>• Thermometer</li> </ul>
<b>Learning Objective:</b>	<ul style="list-style-type: none"> <li>• The trainee should know how to calibrate a meter using the master meter.</li> </ul>
<b>Samples of Behavior:</b>	<p>The trainee should know how to:</p> <ul style="list-style-type: none"> <li>• Set up a master meter</li> <li>• Make a test run with a master meter</li> </ul>
<b>Notes:</b>	
<ul style="list-style-type: none"> <li>• Any safety violation is an automatic failure.</li> </ul>	

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## USE MASTER METER

**Background:** The master meter is equipped with two hoses: one on a hose reel located on the discharge side of the cart, and the other hose, placed in U-hooks around the cart. Both hoses are connected to the discharge or outlet side of the cart. Which hose you use is determined by the flow control valves. The upper valve leads to the hose reel.

The hose on the reel has an over-the-wing nozzle attached on one end. Use this hose when you *can't* adapt to a truck connection or defueling stub. The lower valve directs fuel through the hose stored on the U-hooks. Typically, you find a single point nozzle on the end of this hose. It can have any type dry-break coupler attached to it. The coupler used, is determined by the type fuel passing through the meter you are going to calibrate. Both flow control valves should *not* be open at the same time. The hose stored on the U-hooks is for truck bottom-loading connections, or a defuel stub. The meter (usually an A. O. Smith) is equipped with an automatic stop that trips a valve immediately down-stream of the meter. This automatic stop can be set so the flow can be halted at a predetermined amount of fuel (usually 600 or 1,000 gallons).

The coupler on the inlet side of the cart is adapted for a single point nozzle and has a pressure gauge installed to assure the system is operating. When you calibrate a meter, the temperature of the fuel must be considered, because the fuel passing through the installed meter may have a temperature higher or lower than it is when it passes through the meter on the cart. This is the purpose of the thermometer installed on the outlet side of the master meter.

*To perform the task, follow these steps:*

### Step 1: Set up.

- Move the master meter cart to the meter location. Set hand brake. Ground and bond all equipment. Connect the system hose containing the meter to be tested to the master meter inlet port. . Use either the hose reel or the hose stored on the U-hooks as necessary. Open the flow valve accordingly.

#### **SAFETY:**

**ALWAYS CONNECT GROUNDING DEVICES SO THAT ALL UNITS IN THE TEST ARE GROUNDED.**

- Set the system up to dispense fuel. Tape a thermometer to the pipeline near the installed meter.

### Step 2: Run meter.

- Flush system to ensure no air is in the line and to check flow rate.

#### **SAFETY:**

**DO NOT OPERATE THE MASTER METER AT FLOWRATES < 30 GPM OR > 600GPM**

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- Reset the master meter and installed meter to zero. Set the automatic stop to cut off at a predetermined number of gallons (usually 600 or 1000 gallons). Energize the system. Dispense the set number of gallons. Deenergize the system.

**SAFETY:**

**NEVER ATTEMPT TO STOP FLOW BY OPERATING THE STEP-STOP VALVE CONTROL LEVER.**

- If for any reason the flow of fuel must be stopped, push the STOP button and hold it.

**Step 3: Take readings.**

- Read the two thermometers. Read both meters. If the temperatures are different, convert the readings to 60 degrees F. Conversion tables can be found in TO 33A6-2-3-1, CALIBRATING THE FUEL METER TANK. If you need a copy, the base fuel accounting office can supply one.

**Review Questions  
for  
Use Master Meter**

Question	Answer
1. How many hoses are on a master meter?	a. 1 b. 2 c. 3 d. 4
2. The hose that is stored on the U-hooks is used to connect to the _____.	a. Defuel stub or truck connection b. Single point adapter on master meter c. Hose on the reel d. Hydrant adapter
3. What type of connection is on the inlet of the master meter?	a. Buckeye adapter b. API adapter c. Single point receptacle d. 352AF adapter
4. Where is the thermometer placed for testing?	a. On the single point connection b. On the hose reel c. On inlet piping of master meter d. On pipeline near installed meter
5. To stop flow through the master meter, you should _____.	a. Pull the STEP-STOP lever b. Push the STEP-STOP lever c. Pull the STOP button and hold d. Push the STOP button and hold

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### USE MASTER METER

Performance Checklist		
Step	Yes	No
1. Has trainee set up master meter and system properly for calibrating? a. Did trainee ground equipment? b. Did trainee set hand brake? c. Did trainee use thermometer properly?		
2. Has trainee successfully established a flow through the meters? a. Did trainee flush system first? b. Did trainee reset meter and set automatic stop?		
3. Has trainee noted the meter readings to continue with calibration? a. Did trainee record meter readings? b. Did trainee record temperature readings and convert if necessary?		

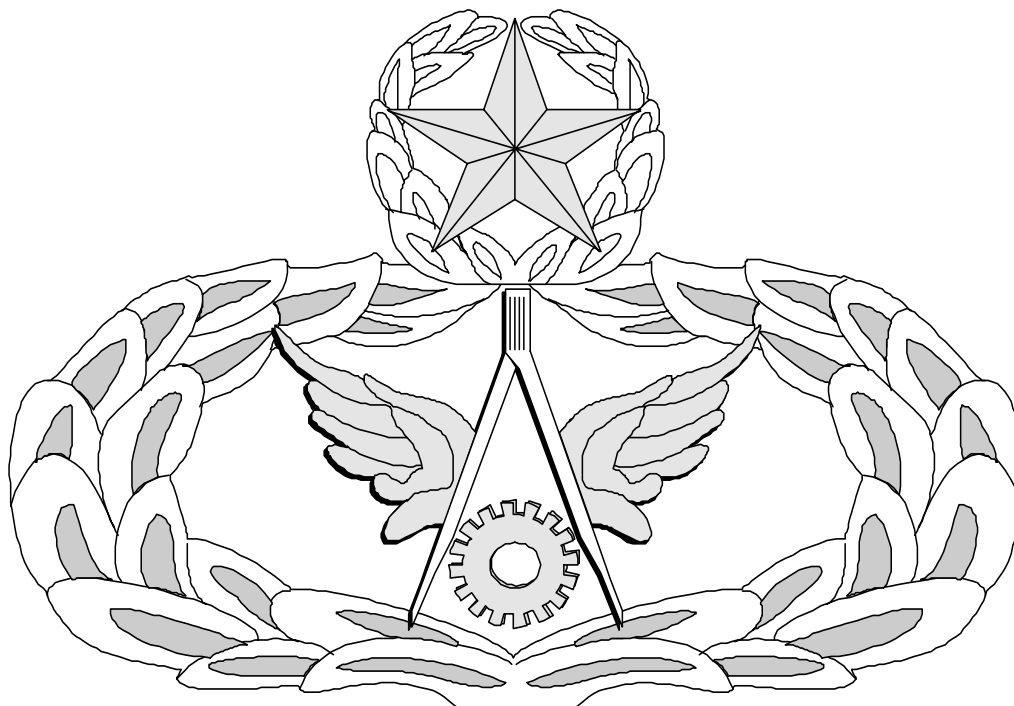
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# **Air Force Civil Engineer**

## **QUALIFICATION TRAINING PACKAGE (QTP)**

### **REVIEW ANSWER KEY**



**For**  
**LIQUID FUEL SYSTEMS MAINTENANCE**

**(3E4X2)**

**MODULE 12**  
**TOOLS AND EQUIPMENT**

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**Key-1**

**USE VAPOR/OXYGEN INDICATOR****(3E4X2-12.4.)**

<b>Question</b>	<b>Answer</b>
1. In what units is the concentration of vapors displayed on the vapor/oxygen indicator?	b. % LEL
2. Before using the meter you must ensure what?	c. Calibration is current
3. What does the FUNCTION switch do?	c. Turn the indicator on and off
4. What voltage must the battery have to use the vapor/indicator?	d. >5.2
5. Which switch is turned to check the battery voltage level?	b. FUNCTION switch to Batt.
6. What do you set the vapor/oxygen indicator GAS SELECT switch to if the vapor being detected is unknown?	a. JP-5
7. When taking a sample, what is the minimum time you should allow the indicator to draw in a sample of the atmosphere?	d. 30 sec

**USE MASTER METER****(3E4X2-12.5.)**

<b>Question</b>	<b>Answer</b>
1. How many hoses are on a master meter?	b. 2
2. The hose that is stored on the U-hooks is used to connect to the _____.	a. Defuel stub or truck connection
3. What type of connection is on the inlet of the master meter?	c. Single point receptacle
4. Where is the thermometer placed for testing?	d. On pipeline near installed meter
5. To stop flow through the master meter, you should _____.	d. Push the STOP button and hold

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